

SECTION 426

WIRING

426.1 GENERAL: This work shall consist of furnishing and installing wiring for traffic signal and highway lighting systems in compliance with the specifications, the details shown on the plans, and Standard Drawings at the locations shown on the plans, or as established by the ENGINEER.

426.2 REFERENCES.

426.2.1 American Society for Testing and Materials (ASTM) Standard Specifications, Latest Edition

B3 Soft or Annealed Copper Wire

B8 Concentric-Lay-Standard Copper Conditions, Hard, Medium-Hard, or Soft

D2220 Poly (Vinyl Chloride) Insulation for Wire and Cable

426.2.2 International Municipal Signal Association (IMSA) Standards, Latest Edition

426.2.3 National Electrical Code (NEC), Latest Edition

426.2.4 National Electrical Manufacturers Association (NEMA) Standards, Latest Edition

426.2.5 Rural Electrification Administration (REA), Standard Specification, Latest Edition

426.2.6 Underwriters Laboratories Standards, Latest Edition

UL83 Thermoplastic-Insulated Wires

426.3 MATERIALS.

426.3.1 GENERAL: Wire and cable shall conform to the requirements of the appropriate sections of IMSA Wire and Cable Specifications and the National Electrical Code and shall carry the UL label. The specified trade size for conductors is copper. Only copper conductors of the trade size specified shall be furnished except as provided by the provisions of this Section 426.

426.3.2 MULTI-CONDUCTOR

426.3.2.1 Multi-conductors shall be polyethylene insulated, poly vinyl chloride or polyethylene jacketed, solid wire signal cable complying with the requirements of IMSA Official Wire and Cable Specification 19-1 or 20-1. (Special multi-conductor cable for direct burial or self-

supporting applications shall be furnished conforming to the description and requirements on the plans.)

426.3.2.2 Conductor color coding shall be in accordance with IMSA Official Wire and Cable Specification 19-1 or 20-1 for unpaired conductor cables. Conductors shall be No.14 AWG size copper or as called for on the plans. Tracer color shall be molten dyed polyethylene co-extruded with the base color.

426.3.3 SINGLE CONDUCTOR

426.3.3.1 GENERAL: Single conductors shall be moisture and heat resistant thermoplastic-Insulated electrical cable rated at 600 volts for installation in conduit and pipe.

426.3.3.2 CONDUCTORS

426.3.3.2.1 Conductors of No. 12 AWG size or smaller shall be solid copper complying with the requirements of ASTM B 3. The wire shall be uncoated unless otherwise specified. Conductors of No. 10 AWG size or larger shall be stranded copper complying with the requirements of ASTM B 8, Class B.

426.3.3.2.2 For conductors specified as No. 3 AWG or smaller, only copper will be acceptable. For multiple lighting circuits and service feeds where No. 2 AWG size copper or larger conductors are specified, the CONTRACTOR may substitute aluminum conductors. Each aluminum conductor shall have an equivalent resistance or less than that of the copper conductor it replaces, and shall be a minimum of two trade sizes larger than the specified copper size. (No. 2 Cu = 1/0 AL, No. 1 Cu = 2/0 AL, 1/0 Cu = 3/0 AL.)

426.3.3.2.3 When the substitution of aluminum for copper conductors requires a larger conduit size to meet NEC requirements than that specified, the larger size conduit shall be provided at no increase in cost to the Owner.

426.3.3.3 INSULATION

426.3.3.3.1 COMPOUND: Conductors shall be insulated with THHN or THWN thermoplastic complying with the requirements of UL-83 Standard for Thermoplastic-Insulated Wires.

426.3.3.3.2 THICKNESS: Thickness of insulation shall conform to the requirements of ASTM D 2220 and the National Electric Code.

426.3.3.3.3 TESTING: Conductor shall be factory tested to determine compliance to U-83 Standard for Thermoplastic-Insulated Wire.

426.3.3.3.4 IDENTIFICATION: Conductors shall have distinctive, permanent markings on the outer surface for the entire length showing manufacturer, type of insulation, size of conductor, and voltage rating. Insulation shall be solid color or of basic colors with a permanent colored stripe the entire length of the conductor in accordance with the specifications or as indicated on the plans or in the special provisions.

426.3.4 COMMUNICATION CABLE: Communication Cable shall be paired polyethylene insulated, polyethylene jacket communication cable with electrical shielding, rated 300 volts, suitable for use in underground conduit. All communication cable shall conform to REA specification PE-39. The conductors shall be solid No. 19 AWG unless otherwise specified on the plans.

426.4 CONSTRUCTION REQUIREMENTS.

426.4.1 GENERAL

426.4.1.1 Wiring shall conform to the appropriate requirements of the NEC and state and local requirements. Wiring within cabinets, pull boxes, and pole bases shall be neatly arranged and laced.

426.4.1.2 Powdered soapstone, talc, or other inert lubricant may be used for inserting conductors into conduit. Bushings shall be installed on all metallic conduit ends before pulling wire to prevent damage to the wire insulation.

426.4.1.3 Conductor splices will be permitted only inside of pull boxes, cabinets, and transformer bases with wiring access. Connections of wiring within standards shall be made at the appropriate terminals. No splicing of suspended cable used on span wire installations will be permitted.

426.4.1.4 For each conductor or cable, a minimum of 4 feet of slack shall be left at each signal or lighting standard and a minimum of 2 feet of slack shall be left at each pull box.

426.4.1.5 Ends of spare conductors shall be taped.

426.4.2 IDENTIFICATION

426.4.2.1 The phase or function of signal cable conductors shall be identified according to the insulation colors shown on the plans. Lighting circuit and signal service conductors shall be identified by black insulation. Two ungrounded multiple lighting conductors shall have black or red insulation. Neutral and common wiring shall have white insulation.

426.4.2.2 Identification tags shall be installed at cabinet, pull box, and pole locations where two or more conductors or cables for different functions have the same insulation colors. Permanent tags of fiber or PVC shall be used for tagging wires.

426.4.2.3 All low voltage circuits for pedestrian push buttons shall be separate from 115 volt function conductors in a separate multiconductor cable as identified at each splice point.

426.4.2.4 Communication cables shall be used for signal interconnect systems. Splicing shall be at splice cabinet or controller cabinet terminals or as shown on the plans. No other splicing shall be permitted.

426.4.3 TERMINALS: Cable wires shall be secured to screw-type terminals in traffic signal heads, pedestrian push buttons, and traffic controllers or as shown on the plans. Spade tongue type connectors shall be affixed to conductors using a tool specifically designed for connecting connectors to conductors.

426.4.4 SPLICES

426.4.4.1 Soldered connections will not be permitted for splicing. Splices shall be wrapped with all-weather plastic electrical tape. The entire splice shall be weatherproof. When cables are pulled into conduit, the cable ends shall be taped to exclude moisture. The ends shall remain taped until splices are made or terminal appliances attached. One of the following types of connector shall be used for splicing 600-volt-maximum connectors:

426.4.4.1.1.1 Spring-Type Connector. The wire ends shall be joined with an insulated spring-type connector without soldering. A two-component, self-curing epoxy resin shall be furnished in a double compartment plastic envelope. The splice insulation shall be made by thoroughly mixing the two components in the envelope and, after cutting open one end of the envelope, inserting the wire connection into the epoxy resin and taping shut the open end of the envelope. Sufficient epoxy resin shall be provided to completely cover the connector and exposed

bare wires at the connector.

426.4.4.1.1.2 Single-component, 3M SCOTCHGUARD or approved equal splice insulation may be used in lieu of a two-component mixture. It shall be placed in accordance with the manufacturer's instructions.

426.4.4.1.2.1 Pin and Receptacle Locking-type Connector. The waterproof connector shall be capable of being disconnected without damage. The pin shall be of medium-hard copper material with the portion to be crimped on to the conductor fully annealed. The receptacle shall be of copper material fully annealed. The connector shall be of a size to provide not less than 90 percent ampacity of the conductor being spliced. The connector shall be applied to the conductor using a tool recommended by the connector manufacturer. Soldering will not be permitted. The pin and receptacle shall each have centrally located, recessed locking areas which shall match complementary areas of the housings.

426.4.4.1.2.2 The receptacle shall establish contact pressure with the pin through use of a copper beryllium sleeve spring. The receptacle and pin shall lock together so that the connection will be maintained when a 20-pound tension pull is applied to the attached conductors.

426.4.4.1.2.3 Separate housings shall be provided for the pin and receptacle. The housing shall be made of water-resisting synthetic rubber suitable for direct burial in the ground or installation where subject to direct sunlight. Each housing shall have an interior arrangement complementary to and suitable to receive and securely retain the applicable pin or receptacle. A water seal section shall be provided between the housings at the point of disconnection. A small slot or vent shall be provided along each housing to permit air exclusion. Silicon-type insulating compound sufficient to fill all voids in the assembly shall be placed in the housings before installation of the pin and receptacle.

426.4.5 FUSED SPLICE CONNECTOR

426.4.5.1 A fused disconnect splice connector shall be installed at each ungrounded conductor in Type V luminaire standard bases between the line and load sides on multiple lighting circuits. A similar unfused disconnect connector shall be installed between the load and line sides on the neutral when a neutral is used. Connectors shall be readily accessible from the standard base handhole. Required fused splice connectors shall be considered part of the wiring installation and no separate payment will be made therefor.

426.4.5.2 The splice connector shall enclose the fuse completely and shall be waterproof. The connector shall

separate with the fuse held in the load side when the pole is dislodged. A receptacle-type design shall be used for the line side housing to maintain insulation between the line side electrode and surrounding ground planes. Fused splice connectors may be single or dual housings.

426.4.5.3 Splice connector terminals shall be rigidly crimped on to line and load connectors, using a tool recommended by the connector manufacturer. Terminals shall be insulated and made waterproof in accordance with the connector manufacturers recommendations.

426.4.5.4 Fuses shall be standard midget ferrule type. Fusing for 400-watt lamps shall be 3- ampere for 480-volt and 240-volt circuits and 6-ampere for 120-volt circuits. Fusing for 1000-watt lamps shall be 6-ampere for 480-volt and 240-volt circuits and 10-ampere for 120-volt circuits.

426.4.6 BONDING AND GROUNDING

426.4.6.1 Metallic cable sheaths, metal conduit service equipment, and metal poles and pedestals shall be made mechanically and electrically secure to form a continuous system and shall be effectively grounded. Bonding and grounding jumpers shall be copper wire or copper strip of at least the same cross sectional area as No. 8 AWG. Standards and pedestals shall be bonded by a bonding strip attached to the lower portion of the shaft or base.

426.4.6.2 For nonmetallic conduit systems, a bare copper wire of No. 8 AWG size or larger shall be run in and through all conduit runs, through all pull boxes, and to all poles. These wires shall be spliced at termination points and shall tie into neutral bars at service facilities or control cabinets to become true and functioning common bonds. In addition a ground rod may be installed at each pole or standard on a multiple lighting circuit when called for on the plans. Required ground rods shall be considered part of the wiring installation and no separate payment will be made therefor.

426.4.6.3 A ground rod (electrode) shall be installed at each multiple service point, each traffic signal standard, each cabinet foundation, and each luminaire foundation. Ground rods shall be hard drawn, high-conductivity electrolytic copper fluted rods or bare, round, hard-drawn copper covered steel rods. Ground rods shall be 3/4 inch nominal diameter 10 feet in length, installed as shown on details in the plans. Service equipment shall be bonded to the ground rod by a No. 6 AWG size copper wire enclosed in a 1/2-inch diameter rigid conduit. The portions of ground rods to be encased in concrete shall be wrapped with 3 layers of pipe insulation tape (0.01 inch min. thickness) or placed through one-inch diameter PVC conduit.

426.4.6.4 Metallic conduit in nonmetallic pull boxes shall be bonded by insulated grounding bushings and bonding jumpers. Metallic conduit in metal pull boxes shall be bonded by locknuts. (One locknut shall be used inside and one locknut shall be used outside of each box when the box is not threaded.)

426.5 MEASUREMENT AND PAYMENT.

426.5.1 Wiring and cable will be measured by the linear foot complete in place.

426.4.2 The accepted quantities of wiring and cable will be paid for at the contract unit price per unit of measurement for each of the pay items listed as shown in the bid proposal.